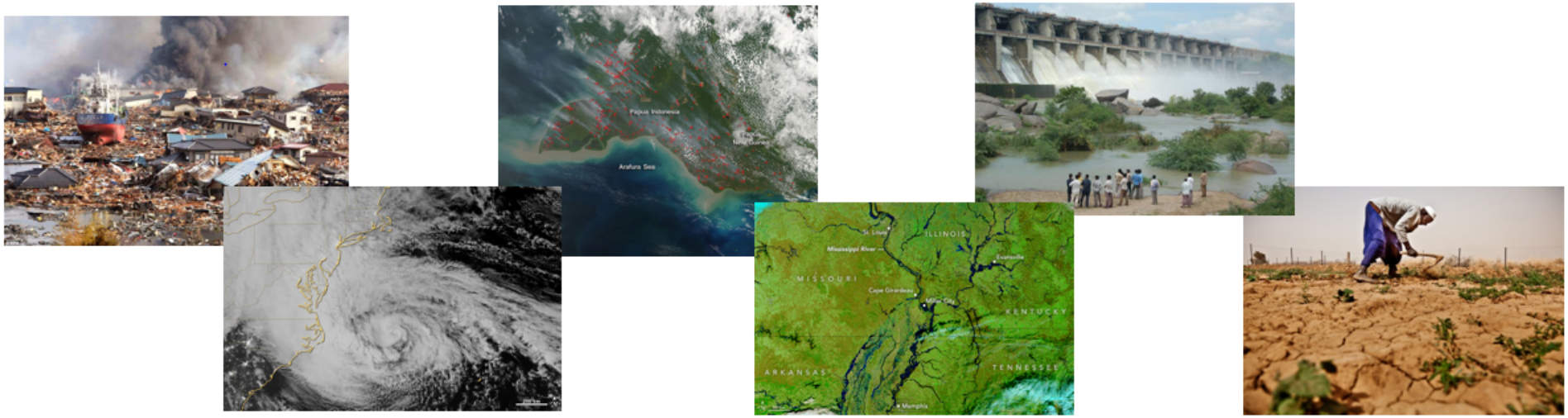
# Goddard Applied Sciences

## Winter 2017 Highlights



# Goddard Applied Sciences

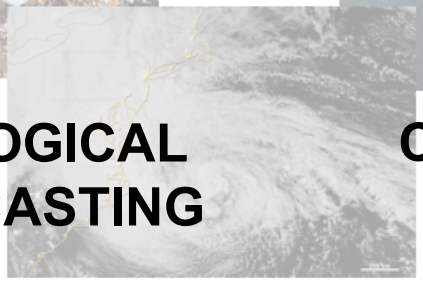
Goddard Applied Sciences brings together NASA Goddard Space Flight Center's vast Earth Science resources for societal benefit. This work is part of the continuum from basic research to applied research to decision-making support for a range of different communities. Goddard Applied Sciences' activities span the range of science and engineering, including Earth Science research, technology, and mission development. Goddard Applied Sciences coordinates projects funded by a variety of NASA programs and missions, connects NASA researchers with end users, supports interagency activities, and develops external partnerships.

Goddard Applied Sciences focuses on several themes, but continues to expand into new areas of research and applications. This slide deck provides many examples of applied sciences work being conducted at NASA GSFC:

**DISASTERS**

**AIR QUALITY & PUBLIC HEALTH**

**WATER RESOURCES & FOOD SECURITY**



**ECOLOGICAL FORECASTING**

**CAPACITY-BUILDING & TRAINING**

**DATA DELIVERY SERVICES**

For more information on these and other areas of active work, please contact: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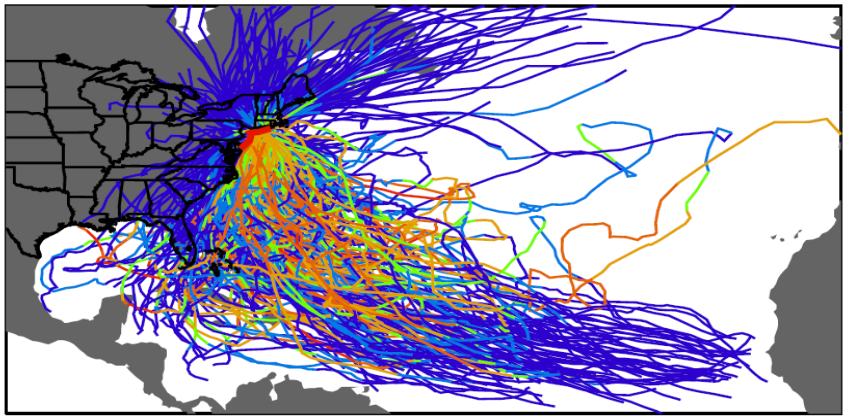
Dr. Maggie Hurwitz (Applied Sciences Coordinator; margaret.m.hurwitz@nasa.gov)

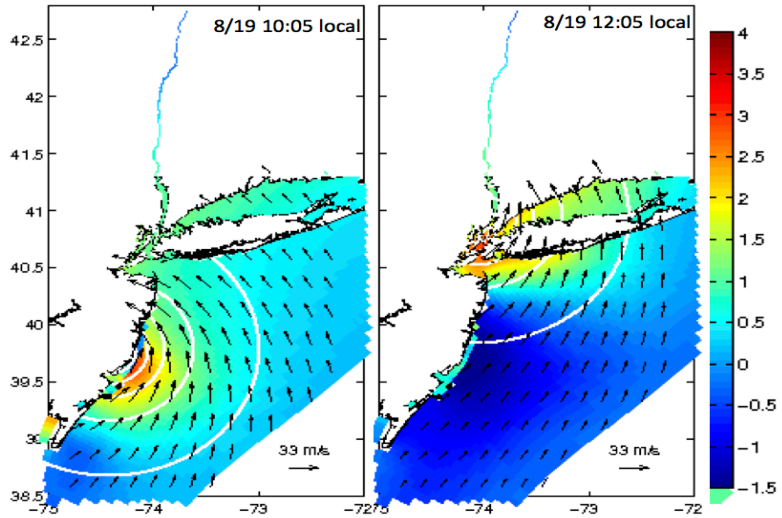
# Disasters

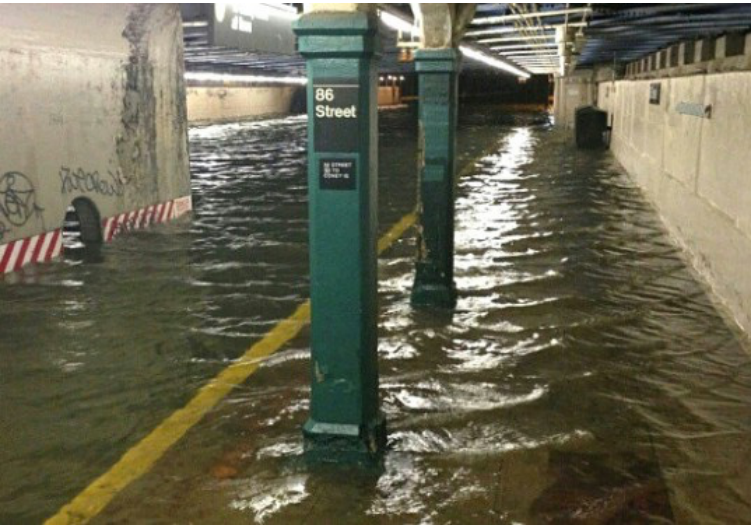
| | | |
|---|---|---|
| Estimating the Probabilities of Severe Storm Events | T. Hall | timothy.m.hall@nasa.gov |
| Lower Mekong Real-Time Flood Monitoring and Impacts | J. Bolten | john.bolten@nasa.gov |
| MODIS Near Real-Time Flood Hazard Mapping in Latin America | F. Policelli | frederick.s.policelli@nasa.gov |
| Solar Activity Forecasts Support US Power Transmission and Homeland Security | A. Pulkkinen | antti.a.pulkkinen@nasa.gov |
| VIIRS Detects Puerto Rico Power Outage | M. Roman | miguel.o.roman@nasa.gov |
| Suomi-NPP Detects Power Outages Caused by Hurricane Matthew | M. Roman | miguel.o.roman@nasa.gov |
| Real-Time Volcanic $SO_2$ and Ash Forecasts | N. Krotkov | nickolay.a.krotkov@nasa.gov |
| NASA Precipitation Data Supports Reinsurance in the Caribbean | D. Kirschbaum | dalia.b.kirschbaum@nasa.gov |
| Landslide Hazard Information for Disaster Response | D. Kirschbaum | dalia.b.kirschbaum@nasa.gov |
| NASA Satellites Track Fires and Burned Areas | C. Ichoku | charles.m.ichoku@nasa.gov |
| Forecasting the Ft. McMurray Fire with NASA's GEOS-5 Model | A. Darmenov | anton.s.darmenov@nasa.gov |

# Estimating the Probabilities of Severe Storm Events

A statistical storm model, developed at NASA GISS, was used to predict extreme storm surge (upper right) and wind speeds (lower right). Statistical modeling of storm frequency could help city officials and emergency managers better prepare for the impacts of extreme weather events on city infrastructure (lower left). This model is used to predict the likelihood of Atlantic hurricanes and storm surge, Northeast Pacific hurricanes, and US winter storms.





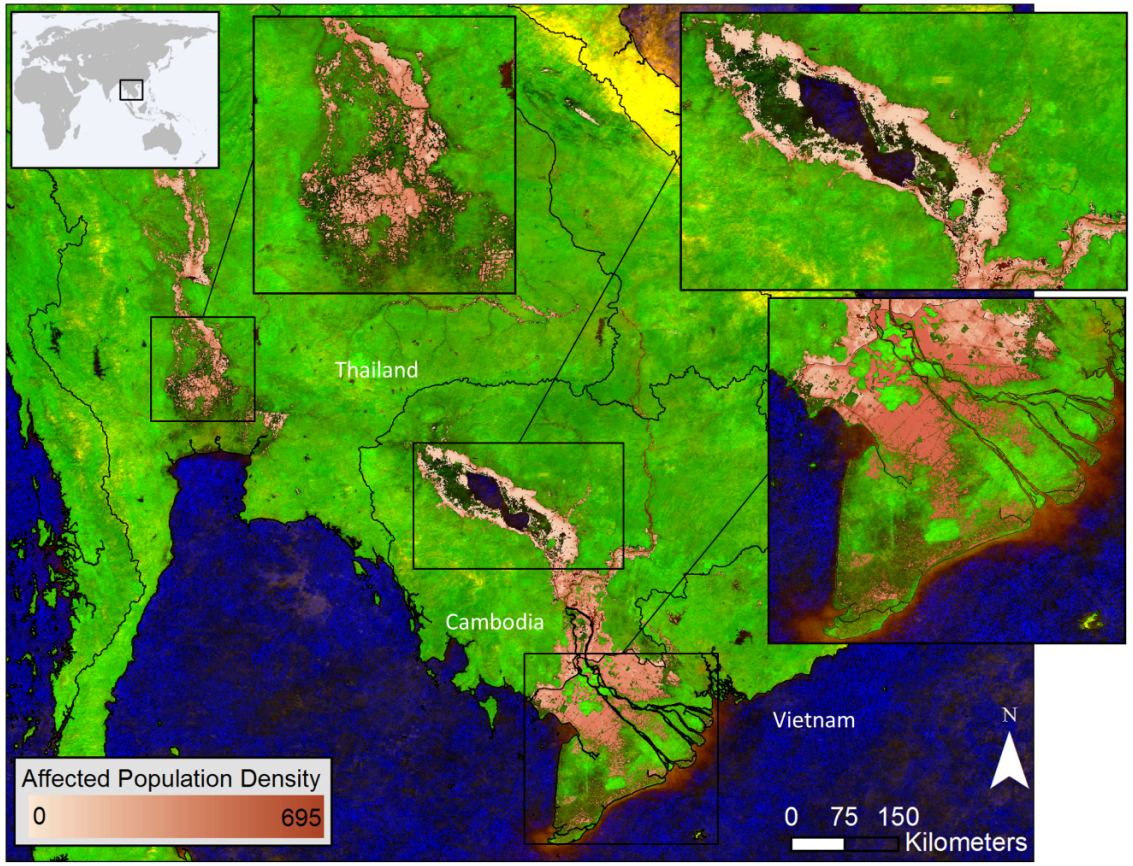

This storm model estimates the probabilities of severe, rare storm events and their sensitivity to weather variability from year to year.

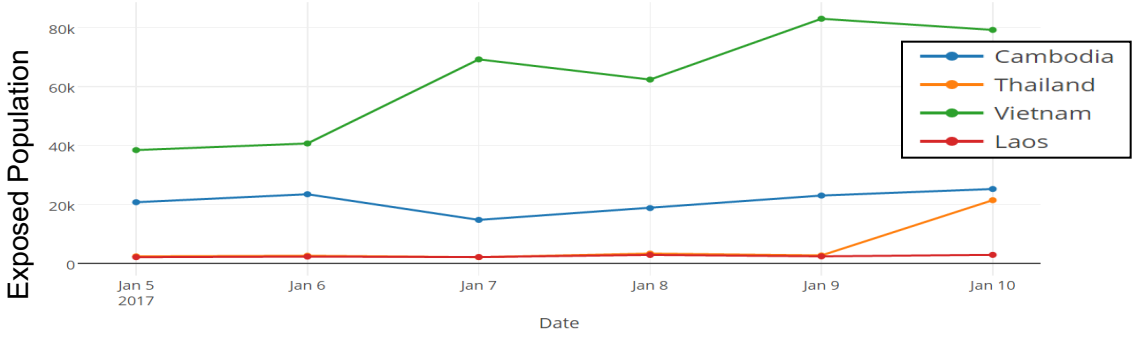
T. Hall and P. Orton (Stevens Institute of Technology)

# Near Real-Time Flood Monitoring and Impacts Assessment Lower Mekong

NASA's MODIS observations, socioeconomic, and historical flooding data, are being used by regional stakeholders including the Mekong River Commission and Asian Disaster Preparedness Center to rapidly identify floods and associated impacts to people and infrastructure in near real-time in the Lower Mekong region.

NASA's near real-time monitoring system was used to estimate the population density of flooded areas in Southeast Asia in October, 2011 (upper right). These MODIS-based estimates were then combined with Worldpop data to calculate the population exposed to flooding (lower right).



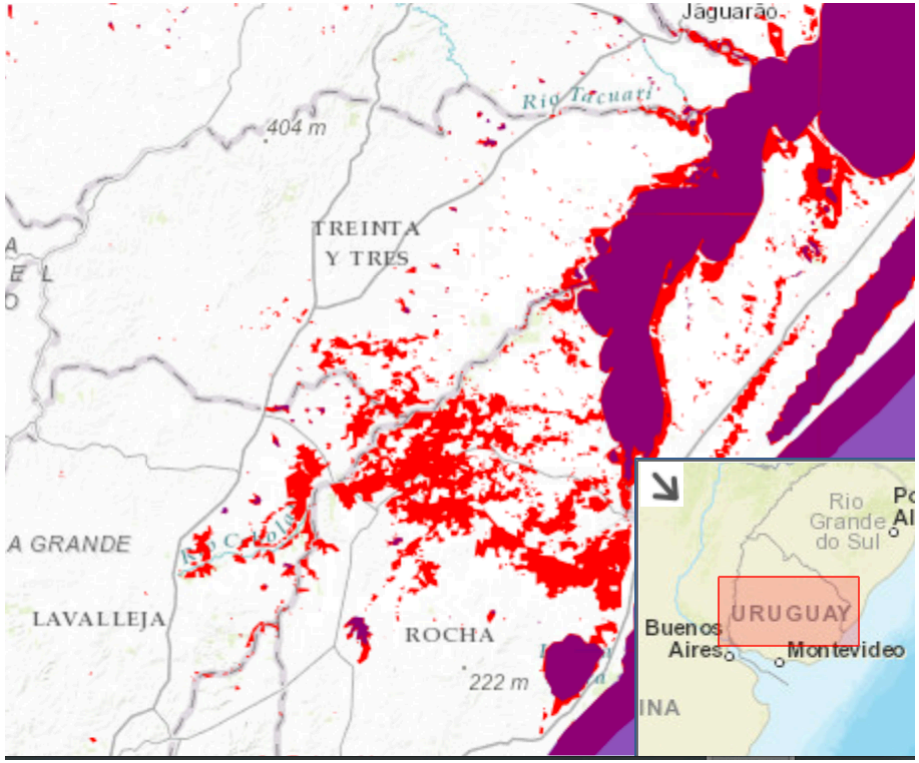




J. Bolten, A. Ahamed (NASA/USRA)
http://projectmekongnasa.appspot.com

# MODIS Flood Hazard Mapping in Latin America

More than 60 agencies in Latin America and the Caribbean participate in GeoSUR, a data service funded by the Latin American Development Bank and USAID. GeoSUR now distributes NASA's near real-time flood mapping product to its users.

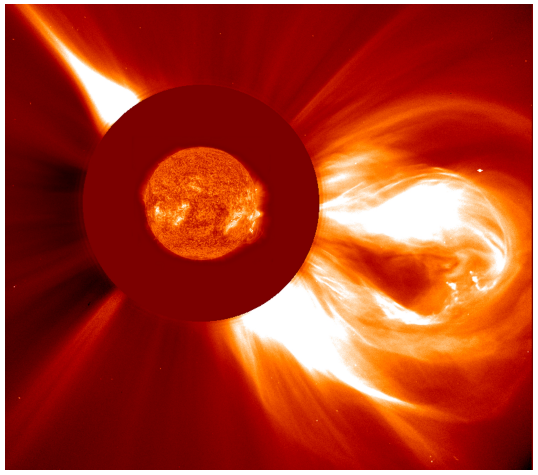
The Dartmouth Flood Observatory ingests and processes NASA MODIS near real-time data, then distribute an open-source Web Maps to the global flood mapping project, its partners and the public. This system has been used to map floods in Latin America in near real-time, such as flooding in Uruguay in January 2017 (right, red shading). Over time, this global flooding record enhances flood hazard evaluation.



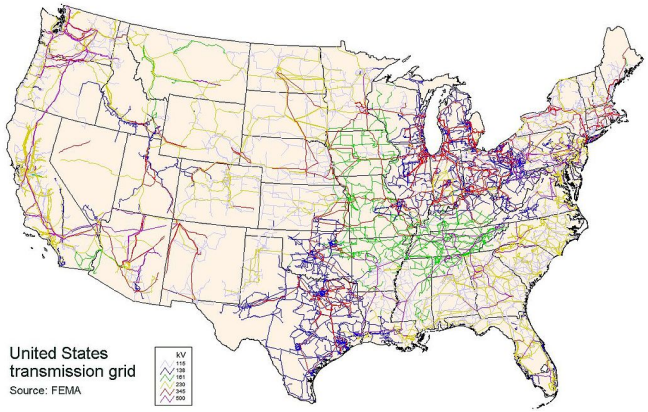

F. Policelli, D. Slayback (NASA/SSAI), R. Brakenridge (Dartmouth Flood Observatory)
https://oas.gsfc.nasa.gov/floodmap/

# Solar Activity Forecasts Support US Power Transmission and Homeland Security

Solar Shield is NASA's state-of-the-art forecasting system for Geomagnetically Induced Currents (GIC), a space weather phenomenon that affects high-voltage power transmission. Solar Shield is being developed in collaboration with the Department of Homeland Security. Analyses of extreme GIC events are being used to inform the North American Electric Reliability Corporation and Federal Energy Regulatory Commission's engineering hazard assessment.



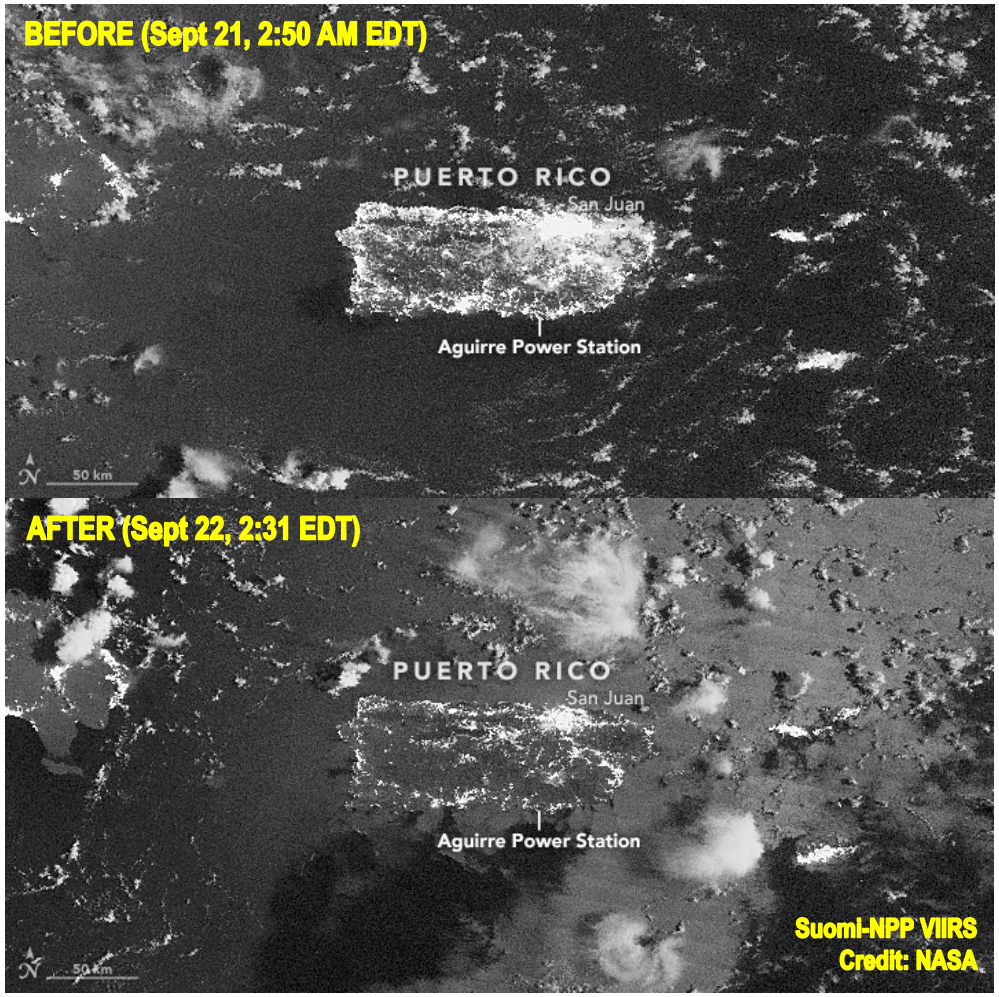
NASA scientists have established a network of GIC observation sites across the US (right). This work is carried out in close collaboration with the US power transmission industry.




GIC research and applications is one example of the Heliophysics Science Division's mission to better understand the effects of space weather on satellites, radio communications, power grids and human spaceflight.

# Satellite Detection of Puerto Rico Power Outage

On September 21st 2016, a major power outage occurred in Puerto Rico that left 1.5 million customers without power, owing to a fire at a substation at the Aguirre power station in Salinas, PR.



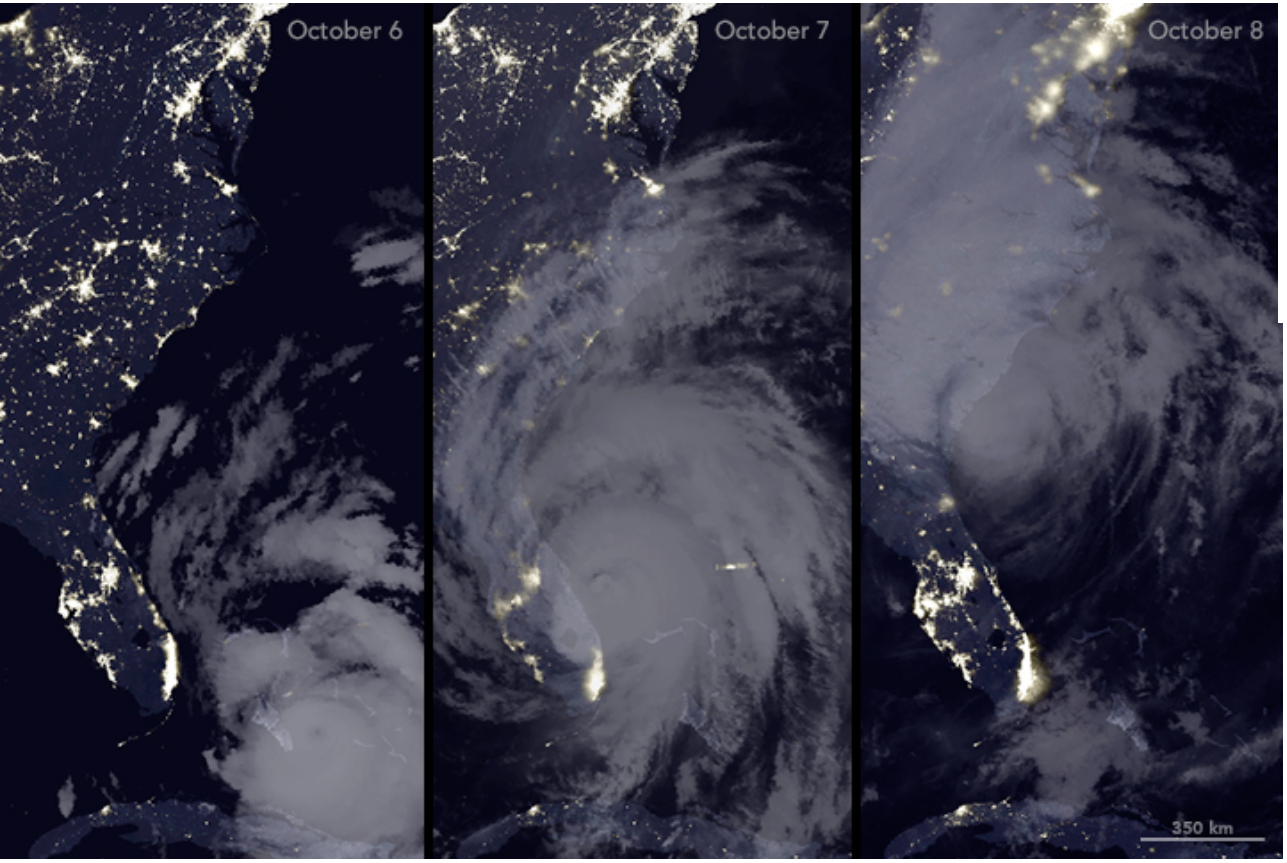

Nighttime imagery from the VIIRS instrument aboard NASA's Suomi-NPP satellite before (top) and after the event (bottom) shows the extent of power outages across major urban areas. VIIRS images were used by PREPA, the Puerto Rican electric power authority, to track the progress of power restoration.

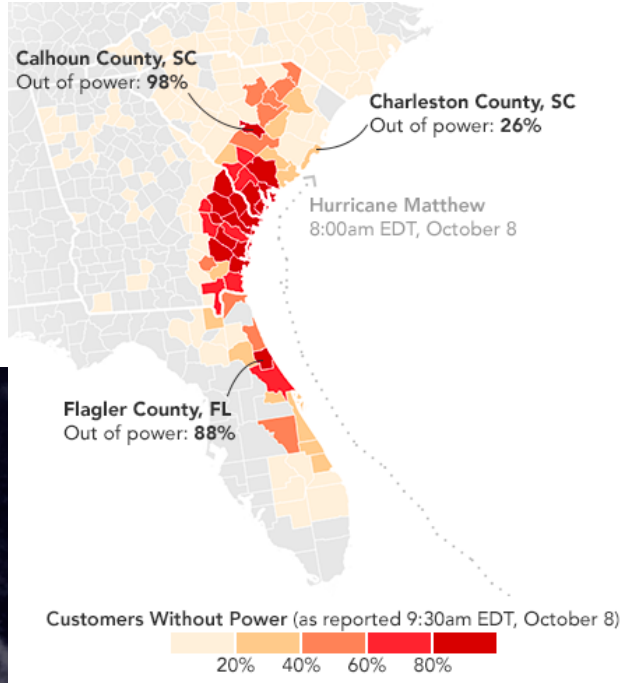
***"These nighttime satellite images help bring a level of situational awareness so we can clearly identify the extent of the impacts into key lifelines of a city's infrastructure"***

***-David Green, NASA Disaster Response Program Manager***

# Suomi-NPP Detects Power Outages Caused by Hurricane Matthew

Nighttime images from NASA's Suomi-NPP satellite provide spatially detailed maps to study the effects of, and human response to, natural hazards. NASA scientists are teaming up with FEMA responders to contribute near-real time power outage maps.



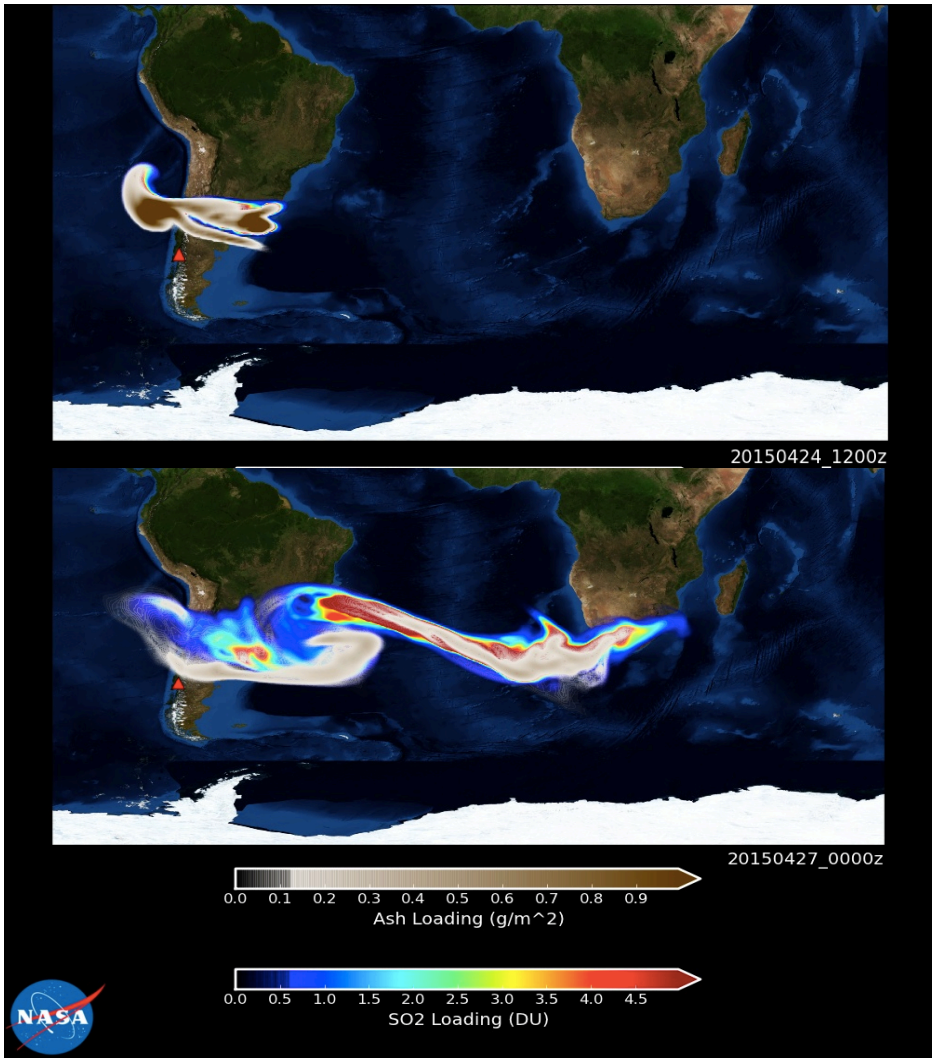

Comparing Suomi-NPP images before and during Hurricane Matthew's landfall on the Carolina coast (left) helped identify areas without power. These images were in good agreement with the region's electricity providers (above).

# Real-Time Volcanic $SO_2$ and Ash Forecasts

NOAA/NESDIS distributes NASA volcanic $SO_2$ data from the Aura satellite's Ozone Monitoring Instrument (OMI) to operational users in near real-time.

NASA's satellite monitoring of volcanic plumes supports the Aviation Control Service (ACS), delivering information about volcanic plumes to 260 subscribed users, such as the Volcanic Ash Advisory Centers, pilots and airlines.

Volcanic data are processed in real-time to develop volcanic $SO_2$ and ash forecasts. These forecasts are based on near real-time data from ultraviolet and infrared sensors on NASA's Aura, Aqua and Suomi-NPP satellites. The NASA GEOS-5 model, fed by these datasets, was able to simulate the evolution of the volcanic ash plume generated by the Calbuco eruption in 2015 (right).

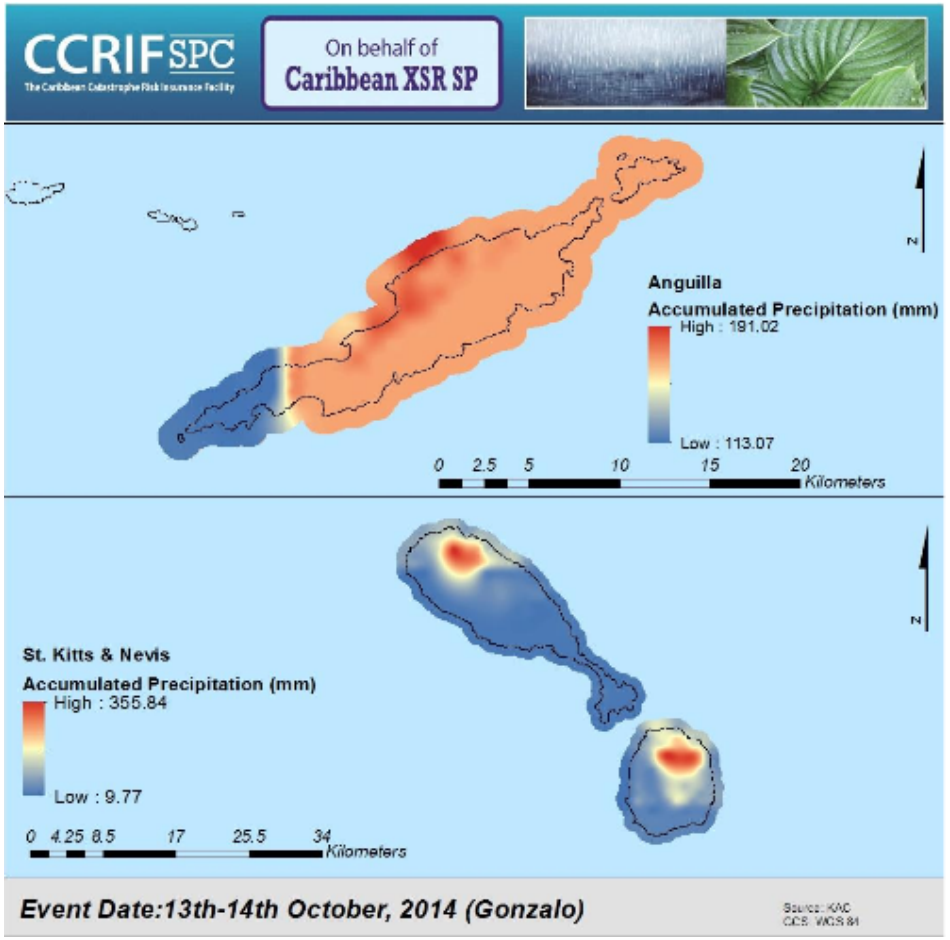



N. Krotkov
http://so2.gsfc.nasa.gov

# NASA Precipitation Data Supports Reinsurance in the Caribbean

Reinsurance company Swiss Re is using NASA's Tropical Rainfall Measuring Mission (TRMM) to determine the potential loss from heavy rainfall events. A pilot program for the Caribbean Catastrophe Risk Insurance Facility (CCRIF), which was launched in 2014, used TRMM coupled to a portfolio of country-wide exposure to determine potential loss from heavy rainfall events. In 2014, the program paid out four times (twice to Anguilla, once to St. Kitts and Nevis and once to Barbados) (right).

Swiss Re's newest micro-insurance program, launched in Guatemala in 2016, uses TRMM data coupled to a loan portfolio to determine micro-loan recipients for those affected by heavy rainfall.

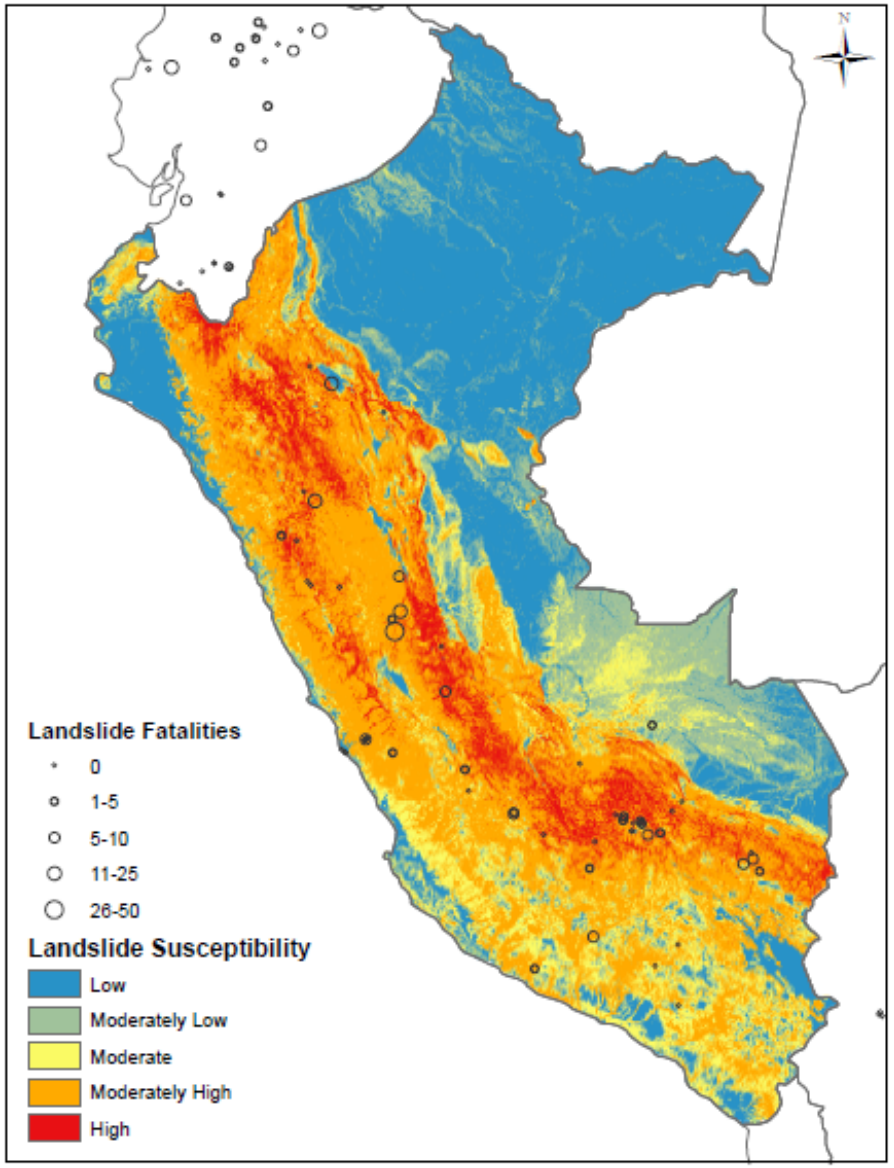



***"We rely on the TRMM and satellite-based rainfall… Satellite rainfall allows us to easily develop a conceptual overview for almost any client"*** ***-Megan Linkin, Swiss Re***

# Landslide Hazard Information for Disaster Response

The US Army Southern Command (SOUTHCOM) used NASA landslide susceptibility (right) and rainfall information to support response efforts in Peru during the 2015-16 El Niño event. This information was used to brief the American Embassy in Peru and support the Ambassador's El Niño Working Group.

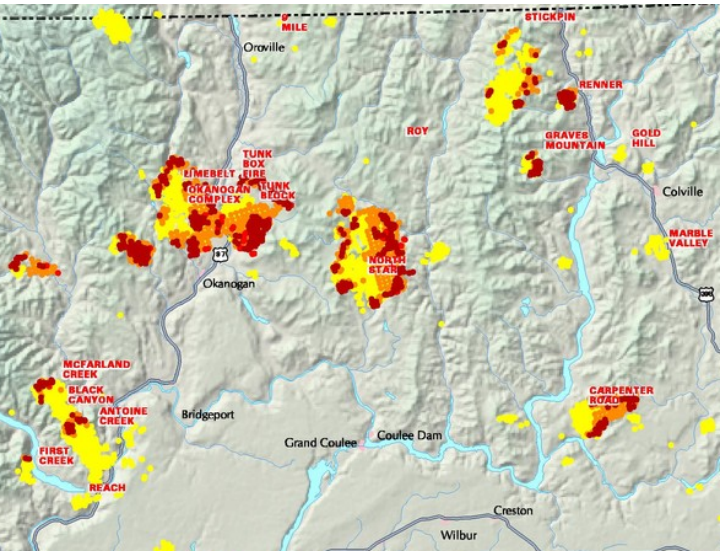
NASA landslide susceptibility, hazard, and rainfall data are available globally in near real-time and have been used by many international and domestic organizations, such as the World Bank, World Food Programme, Pacific Disaster Center, FEMA, and the US Army Corps of Engineers.




*Peru landslide events and susceptibility*

D. Kirschbaum, T. Stanley (NASA/USRA)
https://pmm.nasa.gov/precip-apps

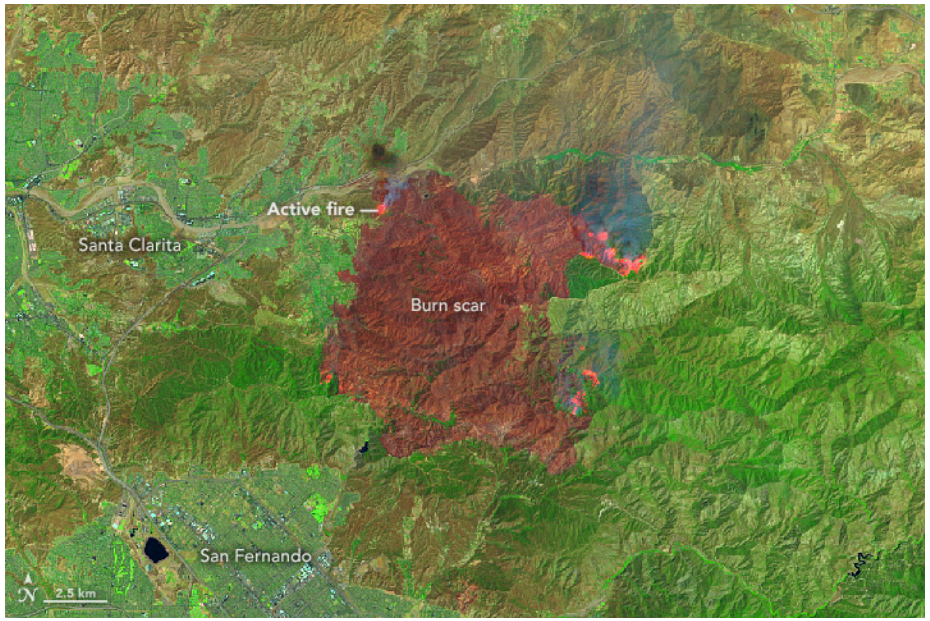
# NASA Satellites Track Fires and Burned Areas




NASA satellites often provide the first indication that a fire has started and give accurate information to local officials about the location, size and severity of fires. NASA has built a decades-long record of global fires.

NASA MODIS and VIIRS data are used to construct maps of active fires and their strength (left). The US Forest Service uses these maps to make decisions in near real-time.

Also, NASA satellites can track recently burned areas (right). These maps give local emergency managers information to aid in decision-making as they plan recovery efforts and determine how to best use their resources.



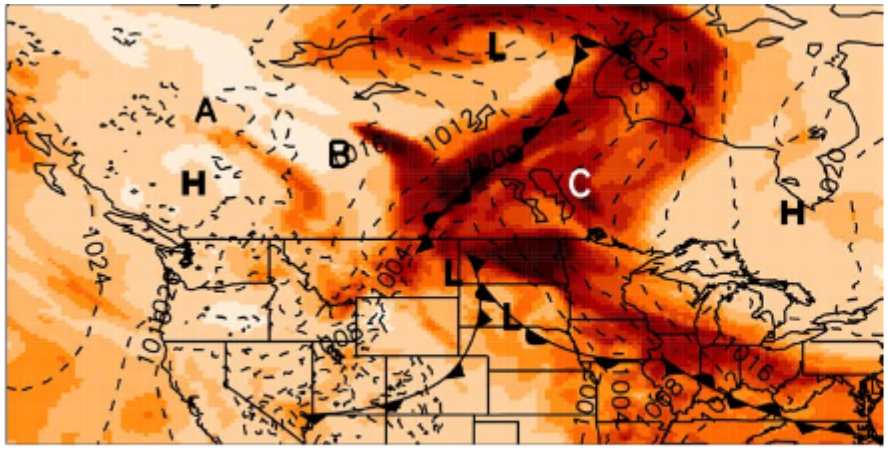

C. Ichoku, R. Kahn, A. da Silva

# Forecasting Ft. McMurray Fire with NASA's GEOS-5 Model

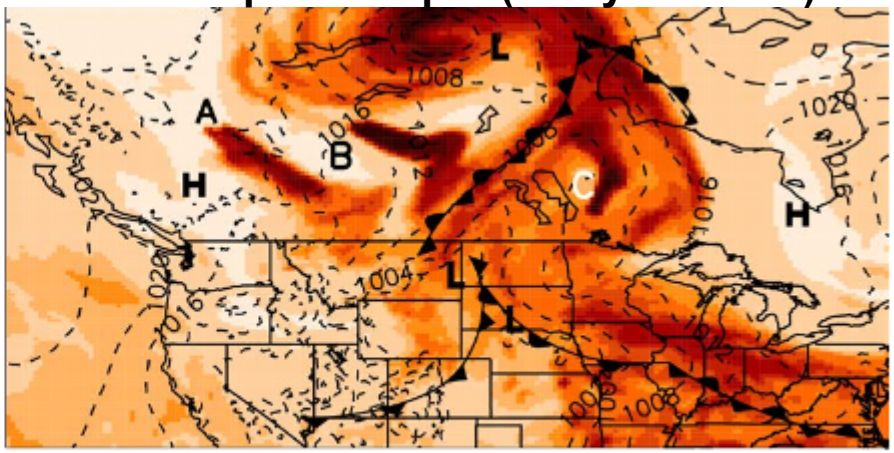
NASA data and weather models can simulate the movement of smoke plumes from wildfires. The NASA Global Modeling and Assimilation Office's new high-resolution capabilities mean that emergency managers can better track the impacts of these fires, including on public health and air traffic.

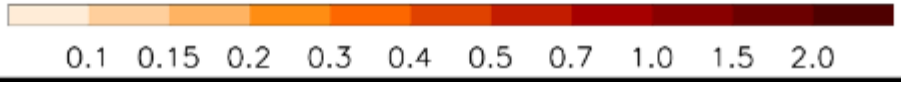
NASA's GEOS-5 model forecasts the evolution of fire pollution plumes in near real-time using information on radiative power from MODIS and weather and aerosol observations. On May 10, 2016, the influence of the Ft. McMurray fires across Canada is evident in the atmospheric analysis (left). GEOS-5 forecasts (right) correctly predicted the transport of pollution to North Dakota, Montana, and Minnesota three days in advance, giving scientists and air quality managers an early warning.

**Aerosol Optical Depth**




**Aerosol Optical Depth (3-day forecast)**




A. Darmenov and A. da Silva
Global Modeling and Assimilation Office, https://gmao.gsfc.nasa.gov/

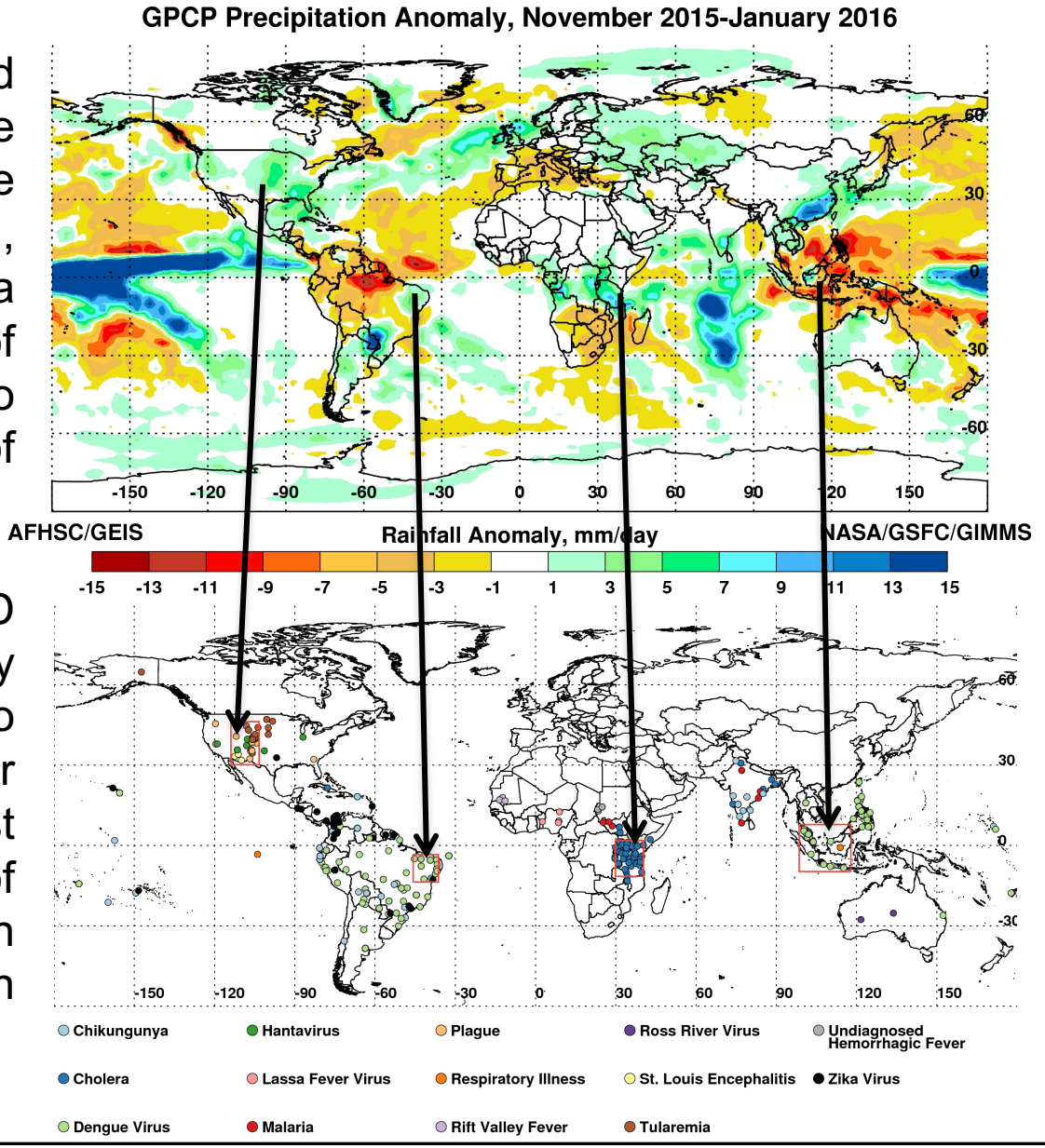
# Air Quality & Public Health

| | | |
|---|---|---|
| **Global Disease Early Warning and Outbreak Assessments** | **A. Anyamba** | **assaf.anyamba@nasa.gov** |
| **Tracking Regional Air Pollution and its Health Impacts** | **B. Duncan** | **bryan.n.duncan@nasa.gov** |
| **Tracking Air Pollution from Sulfur Fires in Iraq** | **N. Krotkov** | **nickolay.a.krotkov@nasa.gov** |
| **Stratospheric Ozone Monitoring Informs Mitigation Policy** | **P. Newman** | **paul.a.newman@nasa.gov** |
| **Understanding the Ozone and Climate Impacts of HFCs** | **M. Hurwitz** | **margaret.m.hurwitz@nasa.gov** |

# Global Disease Early Warning and Outbreak Assessments

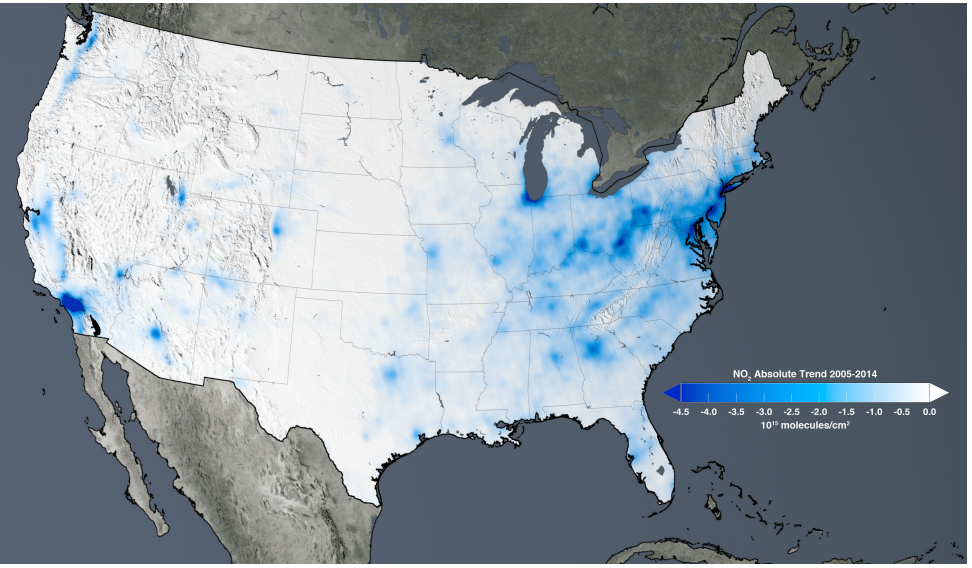
Unusual temperature and precipitation conditions can drive global vector- and water-borne pandemic diseases. Each month, NASA vegetation and weather data are combined with a database of historical disease outbreaks to provide an early assessment of potential disease outbreaks (right).

This information enables the DoD and host country partners to deploy early surveillance resources to prevent outbreaks or reduce their impacts. In 2015-16, a forecast prompted an early vaccination of livestock, which prevented an outbreak of Rift Valley fever in Kenya and Tanzania.



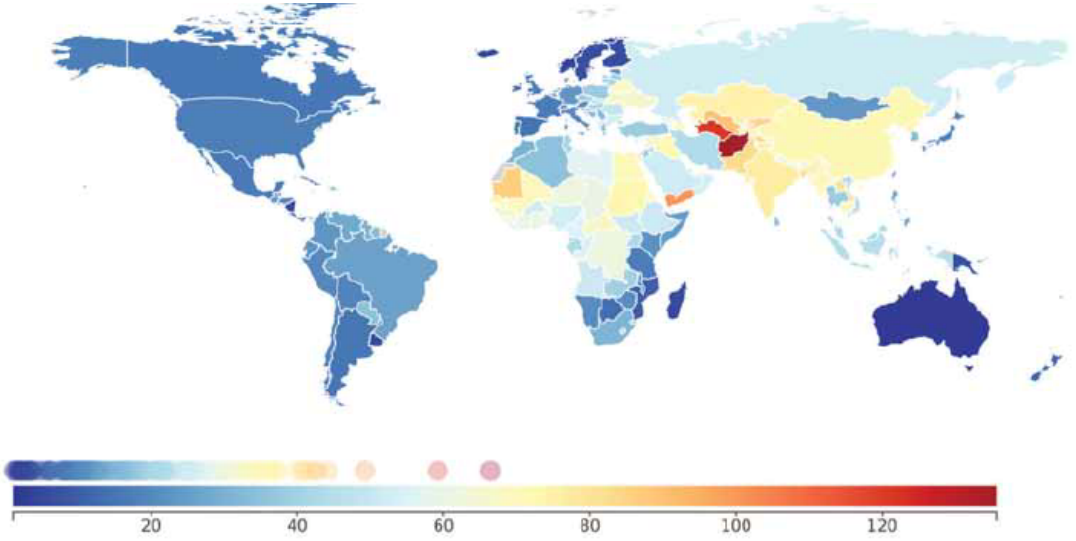

A. Anyamba (NASA/USRA)

# Tracking Regional Air Pollution and its Health Impacts




The Ozone Monitoring Instrument (OMI) aboard NASA's Aura satellite tracks air pollutants, such as nitrogen dioxide ($NO_2$), a common pollutant from cars and power plants, and sulfur dioxide ($SO_2$) from coal-fired power plants, at high spatial resolution. Continuous monitoring allows scientists to detect air pollution trends. Stronger air quality regulations led to a 40% decrease in $NO_2$ pollution in the US (left) between 2005 and 2014.

Atmospheric observations are being used to quantify the health impacts of air pollution. The World Bank's 2016 report, "The Cost of Air Pollution", used NASA's fine particulate matter ($PM_{2.5}$) data to estimate the number of deaths attributable to high levels of air pollution (right).

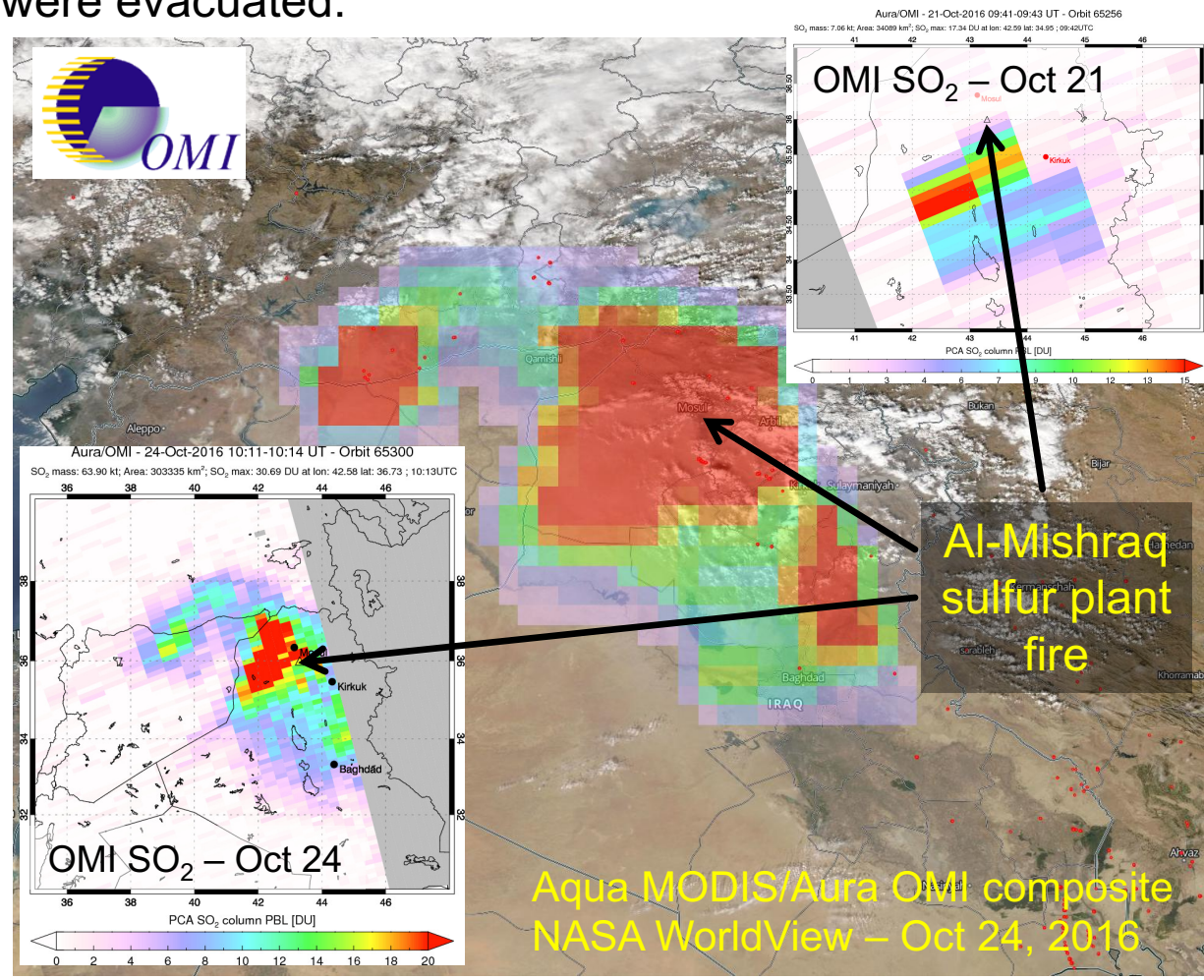



B. Duncan, N. Krotkov, L. Lamsal (NASA/USRA),
A. Thompson, Y. Yoshida (NASA/SSAI), K. Pickering

# Tracking Air Pollution from Sulfur Fires in Iraq

During the battle for Mosul in 2016, a fire at a sulfur plant created a toxic $SO_2$ cloud. The sulfur and smoke caused several deaths and 1000 hospitalizations; 200 families were evacuated.

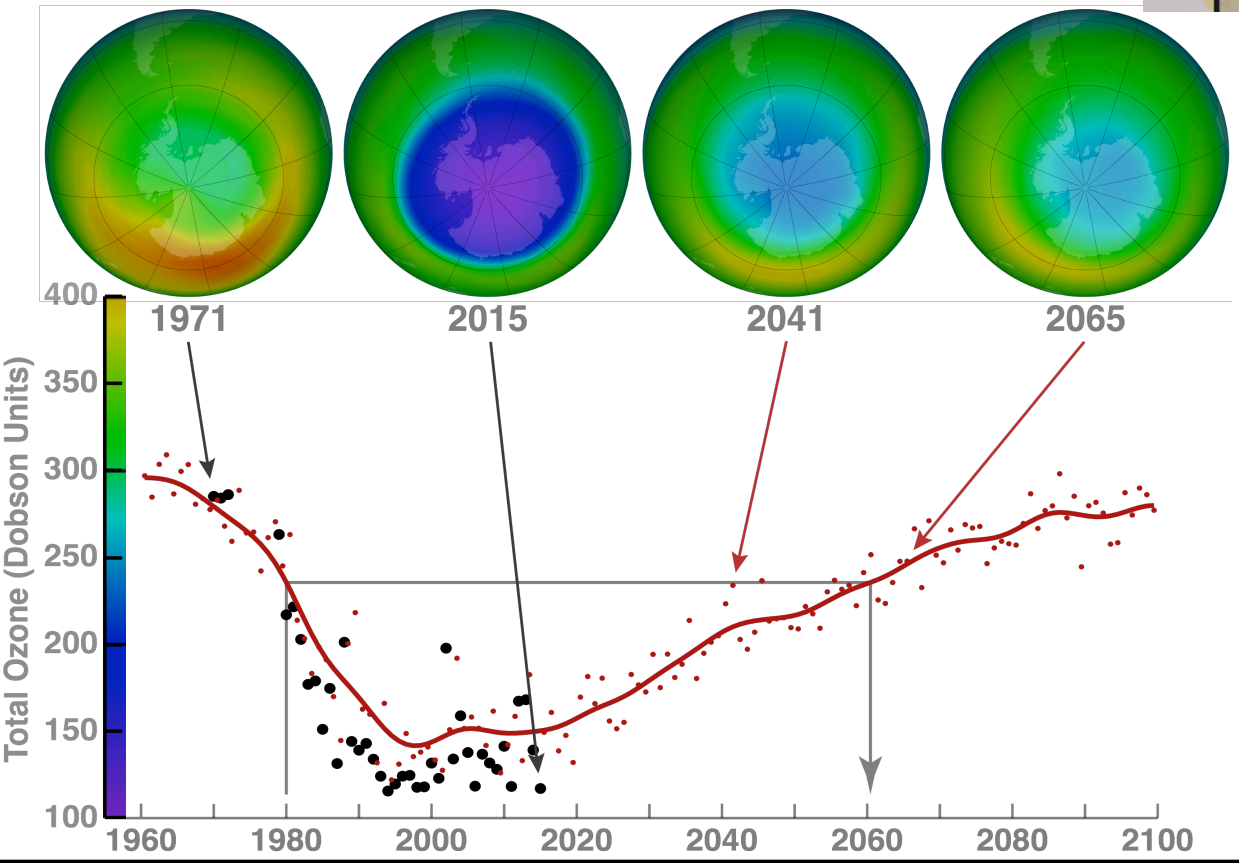
The $SO_2$ emissions from the Al-Mishraq fire were tracked by NASA Aura's OMI instrument (right). NASA's MISR instrument was used to calculate smoke plume heights (above). These products could be used by local authorities to make evacuation decisions, deploy emergency responders and provide aid.




Simon Carn (Michigan Technological University), Can Li (NASA/UMBC), Nick Krotkov and Ralph Kahn

# Stratospheric Ozone Monitoring Informs Mitigation Policy

Aura's Ozone Monitoring Instrument (OMI) and Microwave Limb Sounder (MLS) make vital contributions to our understanding of the chemical & dynamical processes that affect the stratospheric ozone layer. OMI continues NASA's stratospheric ozone record that began in 1970 (black dots, below).


NASA data and analysis have informed policy decisions: NASA satellite data illustrates the success of the Montreal Protocol (above), an international treaty designed to protect the ozone layer. The size and depth of the ozone hole have stabilized. NASA's chemistry-climate model (red line, left) predicts that ozone will return to pre-1970 levels in the mid-21st century.

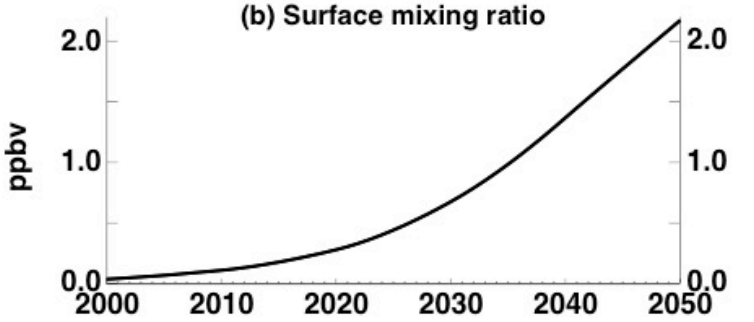
Aura Science Team, P. Newman, L. Oman

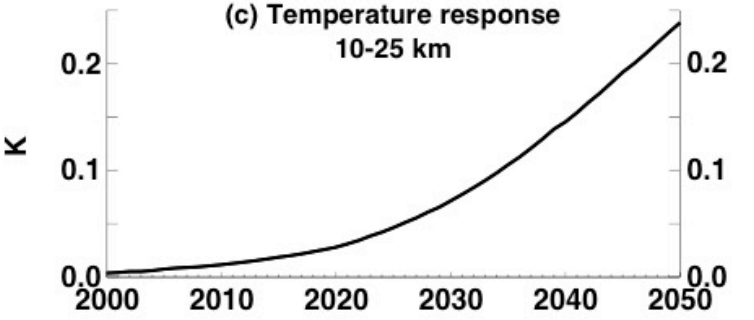
# Understanding the Ozone and Climate Impacts of HFCs

A NASA analysis helped inform the 2016 Kigali Amendment to the Montreal Protocol, an international treaty designed to protect the ozone layer, to manage and restrict future hydrofluorocarbon (HFC) emissions.

HFCs are synthetic compounds that were developed to replace ozone-depleting substances, and are primarily used in air conditioning and refrigeration. HFC concentrations have increased rapidly since 1990, and are expected to continue to increase through the 21st century (center right).

Many HFCs are strong greenhouse gases. Simulations with NASA's GSFC 2D chemistry-climate model show that HFCs could contribute substantially to atmospheric temperature change (lower right). However, more than 90% of the atmospheric temperature impacts of HFCs can be avoided by eliminating emissions by 2030.



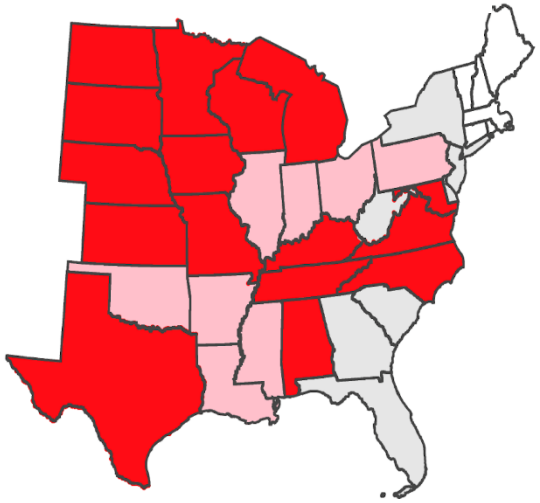

M. Hurwitz (NASA/SSAI), E. Fleming (NASA/SSAI), F. Li (NASA/USRA),
P. Newman, Q. Liang (NASA/USRA)

# Water Resources & Food Security

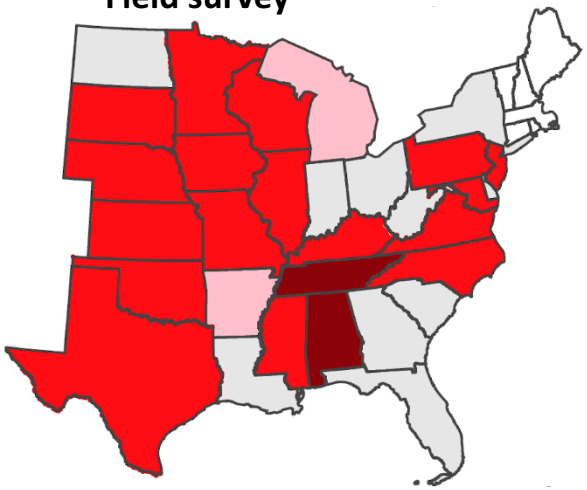
| | | |
|---|---|---|
| **Soil Moisture Products For Improved Agricultural Forecasting** | **I. Mladenova** | **iliana.e.mladenova@nasa.gov** |
| **Famine Early Warning Decision Support with NASA's Land Information System (LIS)** | **A. McNally** | **amy.l.mcnally@nasa.gov** |
| **NASA's Land Information System (LIS): Enhanced Terrain Characterization for Military Applications** | **S. Kumar** | **sujay.v.kumar@nasa.gov** |
| **Operational Tropical Cyclone Tracking with NASA Precipitation Data** | **D. Kirschbaum** | **dalia.b.kischbaum@nasa.gov** |

# Soil Moisture Products For Improved Agricultural Forecasting

Satellite merged product



Field survey



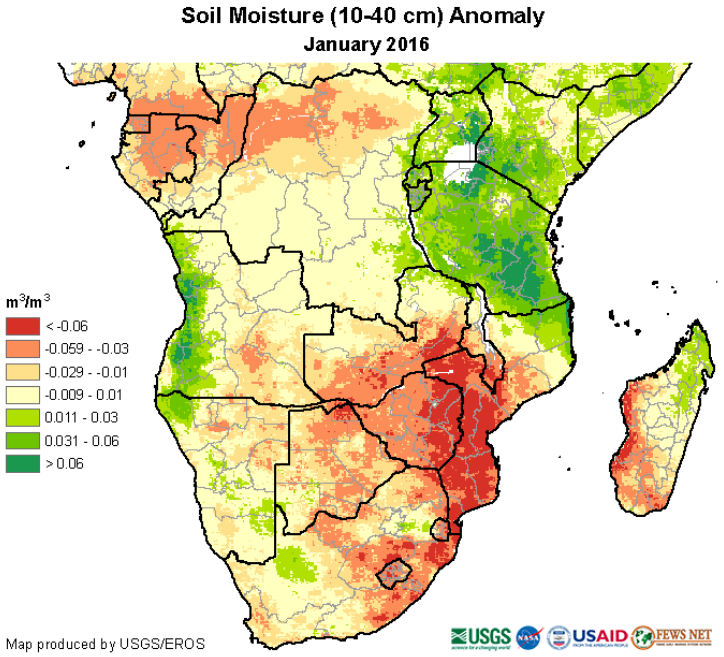

NASA's soil moisture products have been incorporated into the USDA Foreign Agricultural Service's operational agricultural forecasts to monitor global drought and predict long- and short-term impacts on vegetation health and agricultural yields. Merging satellite- and model-based products improves estimates of end-of-season crop yields. The merged satellite and model estimates provide comparable or better performance as compared with costly and labor-intensive survey-based methods.

The satellite merged product (upper left) provided equal or better predictions of end-of-season corn yields for the central and eastern US for the August 2003-2010 period, compared to estimates from field surveys (lower left).

I. Mladenova (NASA/ESSIC) and J. Bolten
http://glam1.gsfc.nasa.gov

# Famine Early Warning Decision Support with NASA's Land Information System (LIS)

The Famine Early Warning Systems Network (FEWS NET) uses NASA's Land Information System (LIS) to monitor agricultural and water resources in Africa. The strong 2015/16 El Niño exacerbated drought conditions in Southern Africa (lower left), negatively impacting livestock, crops and food security (lower right).




*"Zimbabwe declares 'state of disaster' due to drought: More than quarter of population face food shortages as country hit by severe drought, with cattle dying and crops destroyed"*

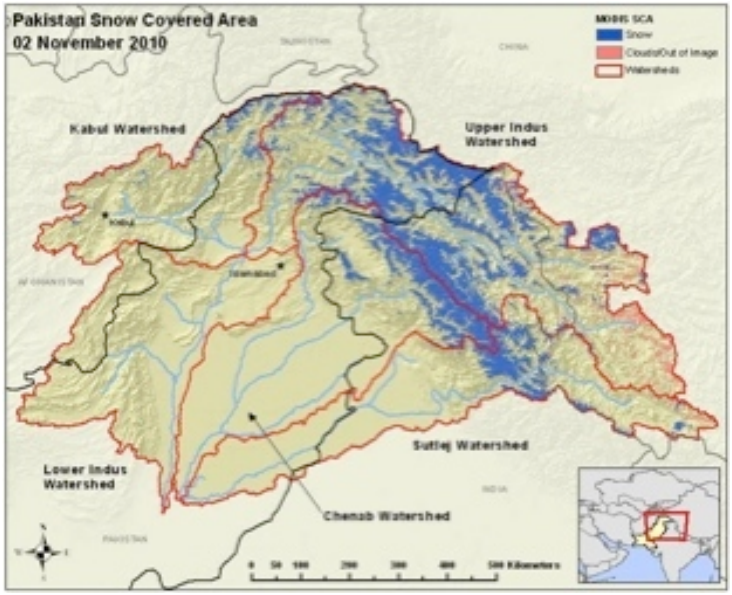
*-The Guardian, 5 February 2016*

Early warning systems help optimize the distribution of limited humanitarian aid resources. NASA satellite datasets are used to corroborate modeled estimates of quantities such as soil moisture. FEWS NET, USAID and USGS use these datasets to create visualizations that meet the needs of the humanitarian community.

A. McNally (NASA/University of Maryland), J. Jacob (NASA/SSAI), K. Arsenault (NASA/SAIC), C. Peters-Lidard, S. Kumar

# NASA's Land Information System (LIS): Enhanced Terrain Characterization for Military Applications

NASA's Land Information System (LIS) is the operational land surface modeling system used by the US Air Force 557th Weather Wing and the US Army Corps of Engineers (USACE) Cold Regions Research and Engineering Lab (CRREL). LIS is used as a decision support tool for military applications, such as assessing snow in remote locations (right) and incorporating the effects of weather on terrain conditions (below).




*Snow assessment in Pakistan*

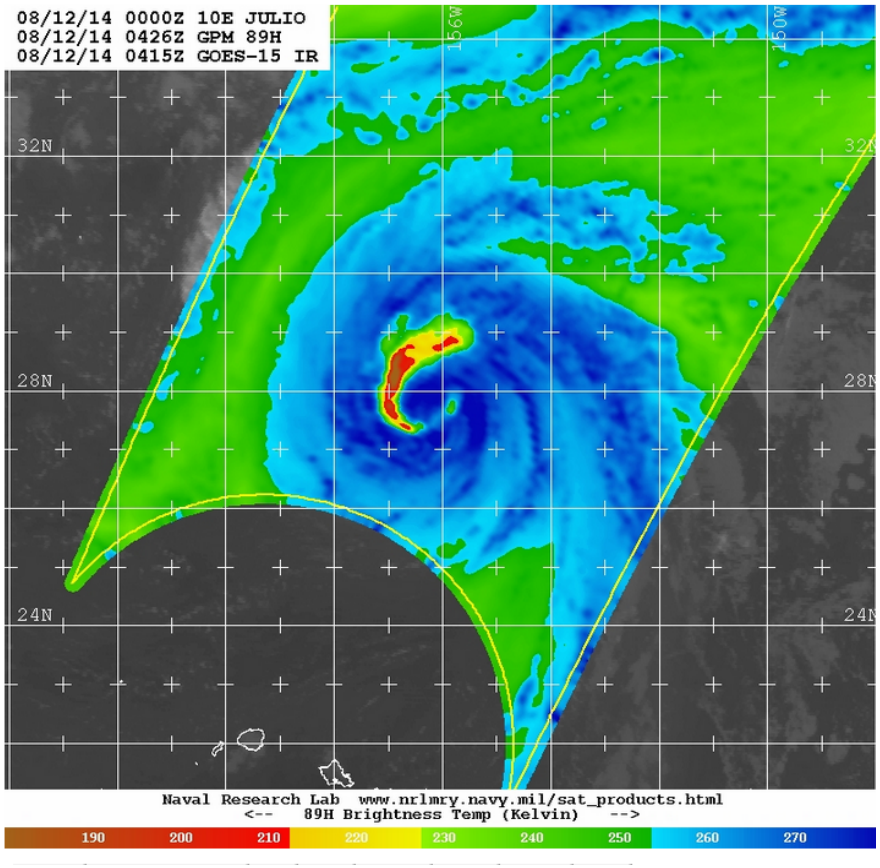

NASA's LIS is a modeling system designed to study land surface processes, such as soil moisture and snow. LIS combines state-of-the-art land surface models and satellite datasets for improved characterization of land surface conditions.

S. Kumar and C. Peters-Lidard

# Operational Tropical Cyclone Tracking with NASA Precipitation Data

The Air Force Weather Agency incorporates data from NASA's Global Precipitation Measurement (GPM) mission into their operational Weather Research and Forecasting Model. This model provides worldwide weather products to Air Force and Army in combat zones as well as to their unified commands, National Programs and the National Command Authorities.

The Naval Research Lab (NRL) routinely uses GPM Microwave Imager (GMI) data along with other sensors in their Automated Tropical Cyclone Forecasting System (right) for improved storm track prediction. The NRL's forecasts are used by weather prediction and disaster response organizations around the world.

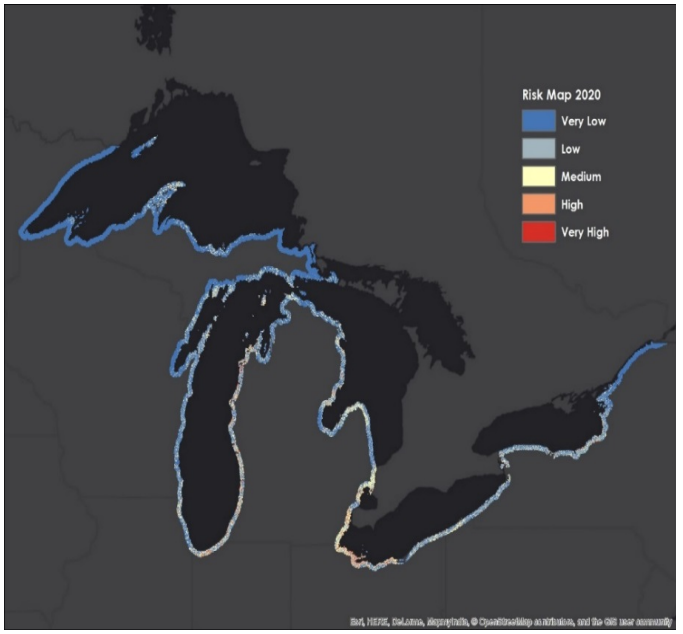


# Ecological Forecasting

| | | |
|---|---|---|
| **Tracking an Invasive Grass Species in the Great Lakes Region** | **S. McCartney** | **sean.mccartney@nasa.gov** |
| **Mapping the Spread of Red Palm Mite in Puerto Rico** | **S. McCartney** | **sean.mccartney@nasa.gov** |

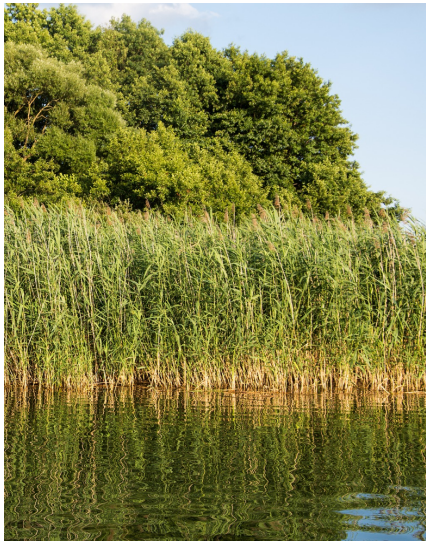
# Tracking an Invasive Grass Species in the Great Lakes Region

Data from NASA's Shuttle Radar Topography Mission (SRTM), Tropical Rainfall Measuring Mission (TRMM) and Global Precipitation Measurement (GPM) were used to both develop a risk map based on habitat suitability for *Phragmites australis* throughout the Great Lakes region and model land change in order to project the risk map for the year 2020 (right).



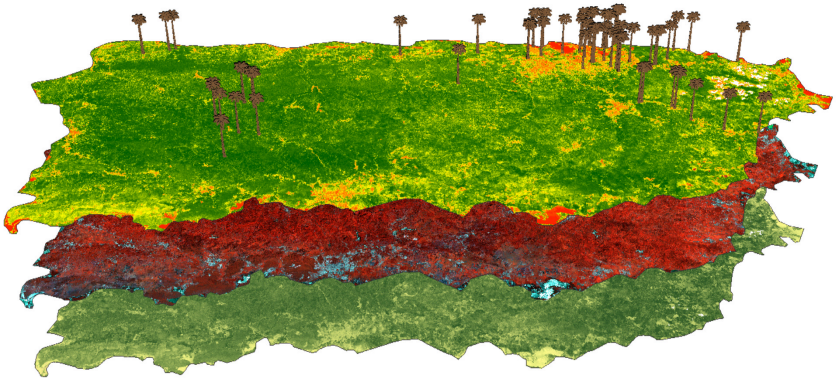

These products were distributed to the Great Lakes and St. Lawrence Cities Initiative, a binational coalition of over 120 US and Canadian mayors and local officials working to advance the protection and restoration of the Great Lakes and St. Lawrence River.

*Phragmites australis* (right) is an invasive grass species that threatens wetland habitats in the Great Lakes and St. Lawrence River basin. Left untreated, *Phragmites australis* outcompetes native regional wetland species, creating an unsuitable habitat for native fish and wildlife and increasing the region's fire risk.



# Mapping the Spread of Red Palm Mite in Puerto Rico

The USDA Agricultural Research Service (ARS) is leading a multinational effort to stop the spread of red palm mite. Understanding the impacts of the red palm mite in Puerto Rico will help the USDA's broader-scale efforts to track this invasive species from space. The distribution of the red palm mite in Puerto Rico was mapped using NASA Landsat images and aerial imagery of the damaged crops (right). Results were distributed to researchers at the University of Puerto Rico.



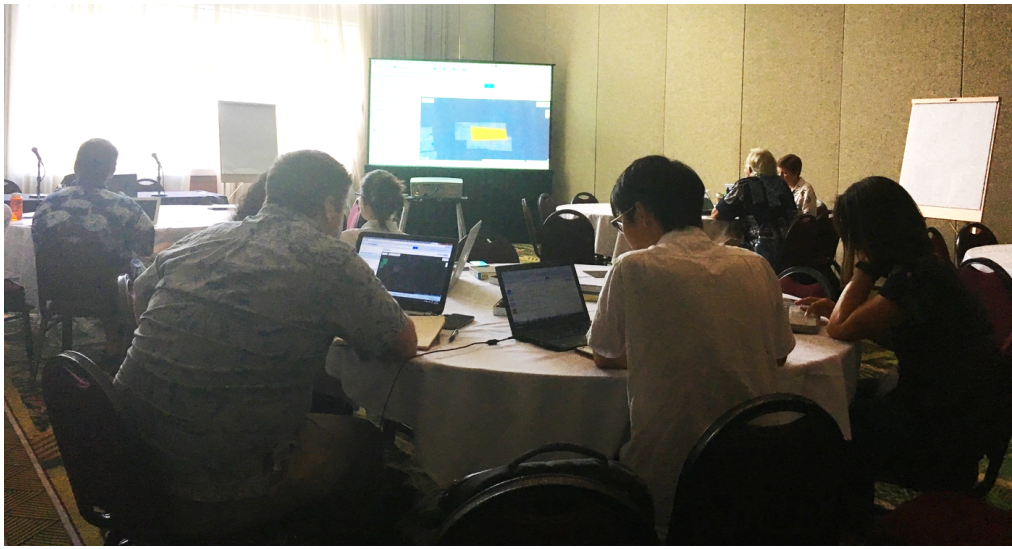
The red palm mite, a microscopic invasive species that devastates coconut palm, banana, and plantain crops, is spreading rapidly throughout the Americas and the Caribbean. Red palm mites feed on plant hosts' leaves, resulting in a characteristic pattern of leaf yellowing (left).

# Capacity Building & Training

| | | |
|---|---|---|
| **Building Capacity for Using NASA Data at the World's Largest Conservation Event** | **A. Prados** | **ana.i.prados@nasa.gov** |
| **From NYC to Rio: NASA Helps Cities Address Climate Risks** | **D. Kirschbaum** | **dalia.b.kirschbaum@nasa.gov** |

# Building Capacity for Using NASA Data at the World's Largest Conservation Event

NASA's Applied Remote Sensing Training program (ARSET) conducted a training on satellite applications for biodiversity conservation at the 2015 World Conservation Congress, the world's largest environmental and nature conservation event. The training was a collaboration between ARSET, Conservation International, Google Earth Engine and the Jane Goodall Institute. 32 attendees from 13 countries learned how to use and apply NASA data.



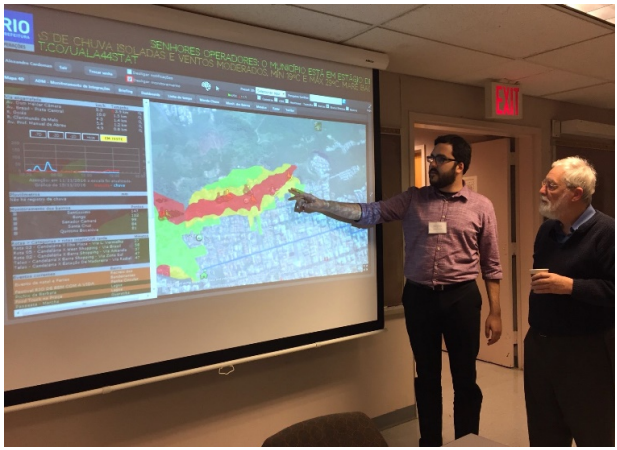
*Participants learned to classify land cover change in Brazil using Google Earth Engine and NASA Landsat data.*

NASA's Applied Remote Sensing Training program (ARSET) provides online and onsite training for environmental professionals, to increase the use of NASA observations and model products to support decision-making. Since 2009, more than 4,000 participants from more than 1,400 organizations and 130 countries have participated in ARSET trainings.

# From NYC to Rio: NASA Helps Cities Address Climate Risks

NASA and the City of Rio de Janeiro are partnering to better anticipate natural hazards and become more resilient to climate impacts. Bringing NASA's Earth-observing satellites and climate projections together with key data collected by the City of Rio de Janeiro provides an integrated view of the city, facilitating geophysical monitoring and decision-making.


In November 2016, ten scientists, engineers and officials from the Rio de Janeiro City Hall visited NASA GISS in New York City (upper right) to exchange best practices and received specialized training on urban heat islands, sea level rise, and water quality. The groups shared their experience with the Rio's 'AlertaRio' system (lower right) and the Urban Climate Change Research Network (UCCRN), with a focus on New York City's climate resilience efforts.




D. Kirschbaum, M. Hurwitz (NASA/SSAI),
C. Rosenzweig, D. Bader (Columbia University), S. Ali Ibrahim (Columbia University)

# Data Delivery Services

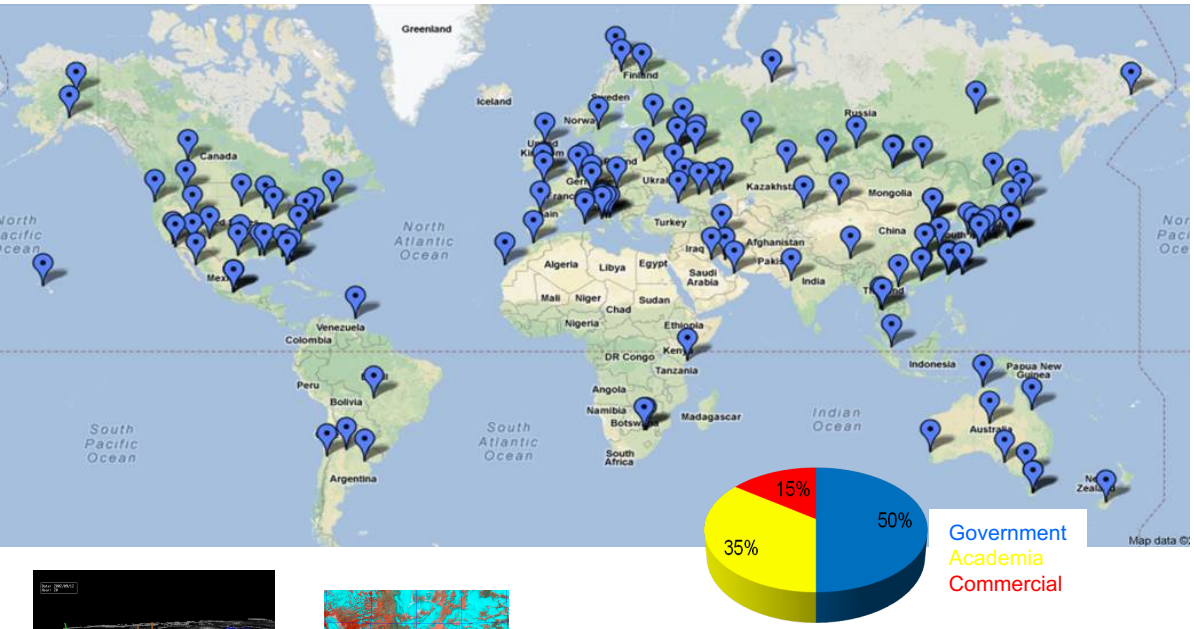
| | | |
|---|---|---|
| **Land, Atmosphere Near Real-time Capability for Earth Observing Systems (LANCE)** | **D. Davies** | **diane.k.davies@nasa.gov** |
| **Direct Readout Laboratory Supports System Applications** | **K. Brentzel** | **kelvin.w.brentzel@nasa.gov** |

# Land, Atmosphere Near Real-time Capability for Earth Observing Systems (LANCE)

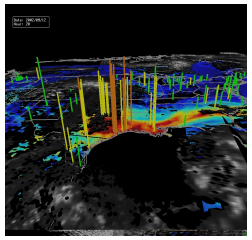
LANCE provides near real-time (NRT) data products within 3 hours of observations to meet the timely needs of applications users. LANCE provides NRT data and imagery from many instruments (AIRS, AMSR2, MISR, MLS, MODIS, VIIRS, OMI) much quicker than routine processing allows. LANCE is used by a broad range of operational and applications users, including USDA-FAS, FEWS NET, the US Forest Service, US National Ice Center, NRL, FEMA, NASA SPoRT, Global Forest Watch, Conservation International, GEOGLAM and the European Centre for Medium-Range Weather Forecasts.

*LANCE provides near real-time data, imagery, and products for air quality applications, dust storms, fires, monitoring vegetation change, floods, ash plumes, drought, smoke plumes, sea ice mapping and severe storms.*

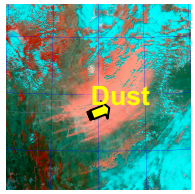
# Direct Readout Laboratory Supports System Applications



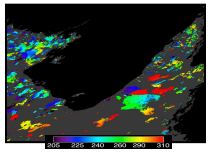

The Direct Readout Laboratory (DRL) provides technology and information to the the Direct Broadcast (DB) community. The DRL acts as an intermediary between missions and DB community members, with over 220 acquisition sites and 2800 registered users.



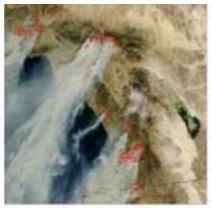
Aerosol –Air Quality



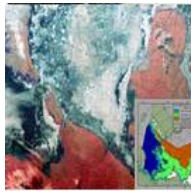

Dust Tracking



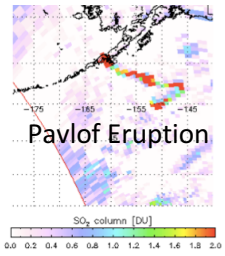
Burned Area



Active Fires



Sea Ice Navigation




$SO_2$

Applications supported through DRL include:

- Fire detection and burned area science algorithms for the generation of fire perimeter mapping and damage assessment
- Volcanic $SO_2$ and ash for air quality monitoring and volcanic plume tracking
- DoD – Naval Research Lab (NRL) real-time plume and dust storm maps to support airborne missions
- Operational real-time generation of Cloud Top Temperature for DoD's AWIPS forecast weather system.